

ZTR

Control Systems

What you have always
wanted to know
about idling locomotives.....

.....But were afraid to ask.

ZTR
Control Systems

What I hope to leave you with today is.....

- *An understanding of some of the complexities involved with shutting down and restarting locomotives.*
- *How technology has helped to automate the performance of this task and turn it into a win-win situation.*
- *Some thoughts regarding sharing the costs of the benefits to be reaped*
- *One easy way to protect your investment*

Let's start with some common ground.....

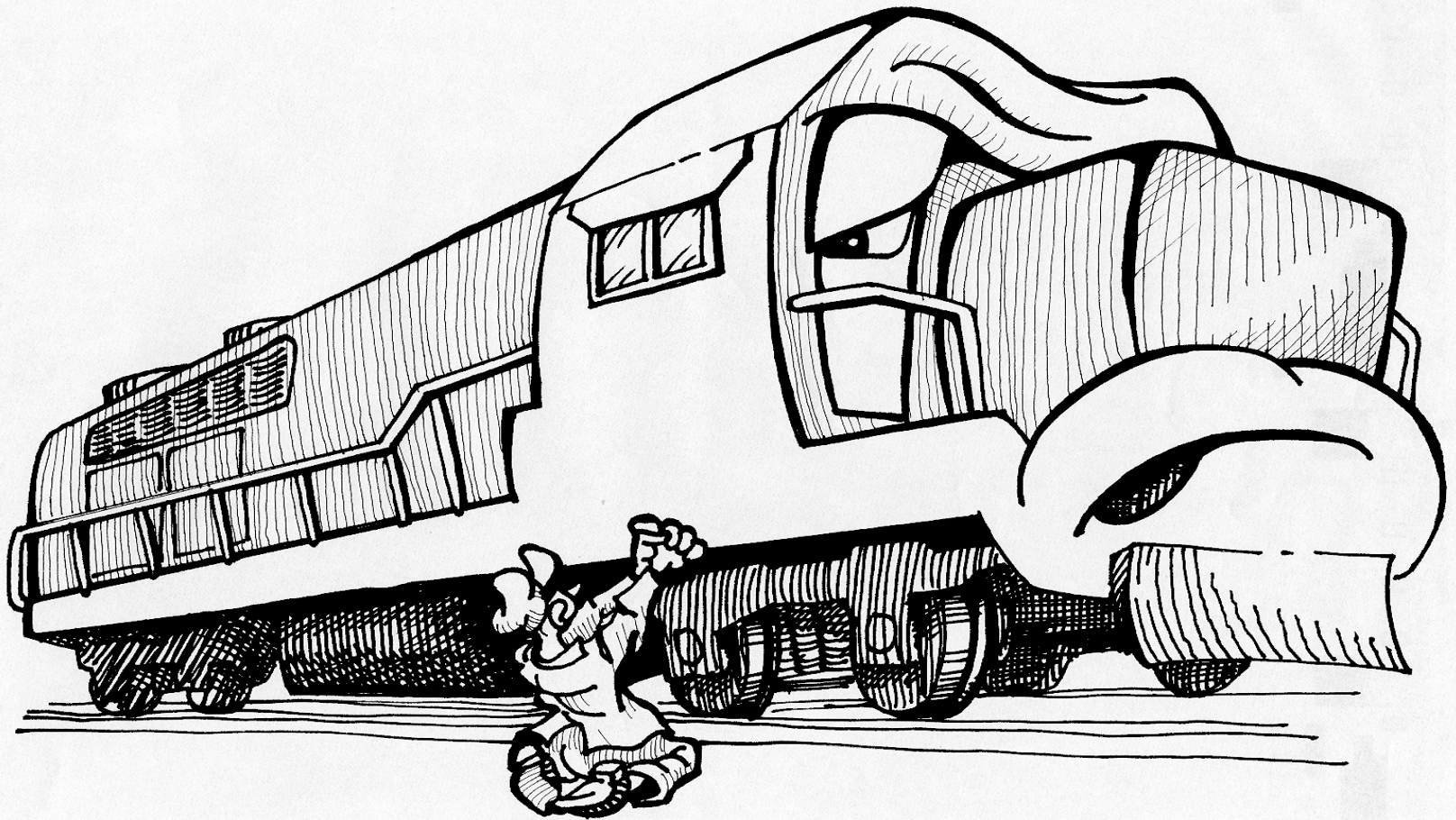
- Shutting down locomotives, when they are not being utilized, saves money and reduces emissions.

*Now if we are all in agreement with this,
then why are we here?*

The answer is.....

- Shutting them down is not the problem!

The problem lies inwhat happens after you shut them down...or try to get them to restart.



Some detrimental incidents that can arise while locomotives are shut down include.....

- **Batteries draining**
- **Coolant leaking into the cylinder**
- **Engine becoming “Cold Soaked”**
- **Outside temperature dropping below freezing**
- **The Dump Valve dumping the coolant**

Manually restarting a locomotive engine, can in itself be a challenge.....

- Some locomotives can be 30 to 40 years old
- Dealing with a variety of different engines
- Horsepower ranges from 1000 to 3000+
- Differences in starting systems
- Unknown condition of batteries

Successfully automating the process was complex and required a microprocessor based product like.....

SmartStart



SmartStart was designed to meet stringent objectives..... Included among these was the need to.....

- Determine if the locomotive should or could be shut down.
- Protect it while it was shut down.
- Be able to reliably restart it.
- Perform all of these tasks safely.
- Be durable enough to live in this environment
- Report on how well it performed its job.
- Provide the user with information not just data.

Port Coquitlam Auto-Stop/Start Lifetime Fuel Savings to 2002-09-30
Total 2,914,557 gallons by 38 units over average 5.30 years each
At \$1.29 per gallon, a total of \$3,759,778.53 has been saved

Gallons of Fuel Saved per Unit

Locomotive Unit Number	Fuel Saved (Gallons)	Fuel Wasted (Gallons)
1003	40,000	32,000
1008	162,000	8,000
1007	45,000	0
1008	135,000	15,000
1009	145,000	8,000
1005	92,000	20,000
1009	98,000	25,000
1008	85,000	22,000
1005	95,000	18,000
1008	85,000	18,000
1009	108,000	12,000
1005	75,000	28,000
1006	82,000	12,000
1006	52,000	35,000
1006	65,000	15,000
1006	55,000	42,000
1006	108,000	0
1003	82,000	38,000
1000	68,000	2,000
1000	72,000	2,000
1000	68,000	2,000
1000	95,000	30,000
1000	65,000	5,000
1000	62,000	5,000
1000	88,000	8,000
1000	78,000	10,000
1000	88,000	0
1000	62,000	8,000
1000	88,000	0
1000	62,000	8,000
1000	98,000	0
1000	68,000	0
1000	72,000	0
1000	58,000	2,000
1000	68,000	0
1000	42,000	0
1005	28,000	18,000
1005	12,000	58,000
1005	42,000	28,000
1005	42,000	0
1008	25,000	2,000
1008	125,000	8,000

Locomotive Unit Numbers

■ Fuel Saved ■ Fuel Wasted

At \$1.29 per gallon, a total of \$3,759,778.53 has been saved



SmartStart has saved our users millions and we're still counting.....

- Actual Fuel Savings on *SmartStart* equipped locomotives operating on a Canadian Class 1 railroad:

(Does not include any savings from their active manual shutdown policy)

▪ Number of locomotives tracked	38
▪ Average period per locomotive	5.3 years
▪ Total fuel saved	2,914,557 gallons
▪ Average fuel saved per locomotive	76,699 gallons
▪ Average fuel saved per locomotive per year	14,471 gallons

- *At about a buck a gallon for fuelnot a bad payback!*

And....think of the reduction in emissions!

2,914,557 Gallons Saved

4 Gallons Per Hour at Idle = 728,639 Hrs. of Reduced Idle Time

A two cycle engine produces 800 Grams of NO_x per hour at Idle

728,639 Hours of Reduced Idle X 800 Grams = 582,911,200 Grams of NO_x

582,911,200 Grams/454grams per lb. = 1,283,945 lbs./2000 lbs. per ton =

642 Tons of NO_x or 17 Tons Per Locomotive

17 Tons/5.30 Years = 3.2 Tons per Locomotive Per Year

*How do we
compile
these
statistics?*



SmartStart Detail Report

Rail Road: _____
Road Number: 1682

Location: OpCenter Demo



Reporting Period

	Installation	Previous Report	Current Report	Since Installation	Previous Report
Date:	12/2/1993	12/6/2003	1/3/2004	Days: 3683.9	28.0
Time:	16:24:06	13:15:50	13:17:46	Hours: 88412.9	672.0

Locomotive Operating Statistics (Hours)

Since Installation			Since Previous Report		
In Service Hours:	74674.1	= 3111.4 Days		672.0	= 28.0 Days
Out of Service Hours:	13738.8	= 572.4 Days		0.0	= 0.0 Days
Since Installation		Since Prev. Report	Since Installation		Since Previous Report
ENGINE SHUTDOWN:	32604.1	273.5	IDLING:	34585.6	389.8
Manual:	2862.4	0.0	Working Idle:	14692.5	56.7
SmartStart:	29741.7	273.6	Parked Idle:	19893.1	333.1
ENGINE RUN:	42070.0	398.5	PARKED IDLE:	19893.1	333.1
Loading:	7484.4	8.7	Unavoidable Idle:	11382.9	298.4
Idling:	34585.6	389.8	Manageable Idle:	8510.2	34.7

Unsatisfied Parameters Preventing Shutdown (Hours)

UNAVOIDABLE					
Ambient Temp:	12207.8	298.5	Water Temp:	50.0	0.0
		0.0	High Water Temp:	0.0	0.0
MANAGEABLE					
Brake Pressure:	2432.7	11.8	Battery Voltage:	0.0	0.0
Battery Charging:	1656.2	22.9	Extended Idle:	26.9	0.0
Reverser not Centered:	506.5	0.0	SS Switch Off:	4248.4	0.0

Reason(s) for Restart After SmartStart Shutdown (Counts) Shutdown (Counts)

Brake Pressure:	12090	78	Ambient Temp:	101	4
Water Temp:	4245	33	Battery Voltage:	1086	30
Reverser:	5587	6			
SmartStart Restarts:	23109	151	Other Restarts:	844	42

SmartStart Shutdown Information

Count:	23953	193	Time:	29741.70	273.60
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SmartStart Savings Analysis

Savings Realized By SmartStart :	\$ 153467.17	\$ 1411.78
Additional Potential Savings NOT Realized By SmartStart :	\$ 29641.03	\$ 120.86
(Based on 67.5 % of Manageable Idle Hours)		

NOTE: Figures based on locomotive fuel consumption rate of 4.0 gallons/hr at \$ 1.29/gallon.

135 / 22 / 11400 / 22833 / 58 / -40 / -40 / -40

*Now think of
the potential
for tracking
emissions
reductions,
credits, etc.*



SmartStart - Hotstart Emissions Report

Rail Road:

Location: OpCenter
Demo

Road Number: 2133



Reporting Period

	Installation	Previous Report	Current Report	Since Installation	Previous Report
Date:	8/28/2002	11/30/2003	12/9/2003	Days: 468.0	9.0
Time:	14:43:01	13:18:39	14:15:50	Hours: 11231.5	217.0

Summary

Gallons of fuel saved by SmartStart - Hotstart	14889.4	63.0
Shutdown hours due to SmartStart - Hotstart	2972.0	14.0

Reduction of Emissions

(Does not include emissions by Kim Hotstart DDHS)

Reduction in NOx due to SmartStart - Hotstart (pounds)	5237.0	24.7
Reduction in PM due to SmartStart - Hotstart (pounds)	170.2	0.8

(These calculations based on locomotive emissions as published by the EPA
Engine: EMD 2 Stroke Notch Position = Idle NOx = 800 g/hr PM = 26 g/hr)

SmartStart - Hotstart reduced the average weighted factor of NOx (g/bhp-hr) by	0.9	0.2
(See table below)		

Table

LOCOMOTIVE ENGINE EMISSIONS - BASELINE DIESEL FUEL

Engine	Notch	Engine Speed	Fuel Flow (lb/hr)	BHP	PM (g/hr)	HC (g/hr)	CO (g/hr)	NOx (g/hr)
EMD 12-645E3B	Idle	300	27	12	21.0	88.0	297.0	776.0

As published in a joint paper to the ASME (Vol 113, July 1991) by the AAR and Southwest Research Institute

What is preventing systems such as *SmartStart* from being applied to locomotives?

- The 3 M's
 - Money
 - Manpower
 - Motivation

- *Given that Money can usually solve items two and threethe question then is how do you get the funding?*

One way to ask your Federal, State or Local Government to Assist

- Obviously there are benefits to be gained by all of these organizations as well.
- But like any good business person, they want to get a high return on their investment.

There have been several concepts put forth to accomplish this type of funding. To that list, I add another that may be of interest.

Shared Savings

Here is how it would work...

Initial System Costs per Locomotive (With Volumes)

- **SmartStart System Costs**
- **Remote Monitoring Costs**
- **Installation Costs**

Approximately \$15,000

Historical Annual Payback in Fuel Savings Alone....

\$14,471

(Based on 38 systems monitored for 5.3 years)

*Let's be conservative and use \$6,000 Annually
in our scenario.....*

The Arrangement.....

- **The locomotive user/owner would be funded the full amount up front.**
- **The funding government body would receive \$3,000 per year from the recipient on the investment over a five year period.**
- **At the end of five years, the cost to the funding government body to support emission reductions would be the cost of money.**
- **The cost per ton on NOx reduced is minimal.**

The Win-Win.....

- **Locomotive User/Owner**

- No initial outlay of capital
- System pays for itself out of actual fuel savings
- Owns the equipment and reaps all savings after the fifth year.

- **The Funding Agency**

- Reduction in emissions
- Payback on investment
- Minimal cost per ton of NOx reduced

Now you may be thinking.....

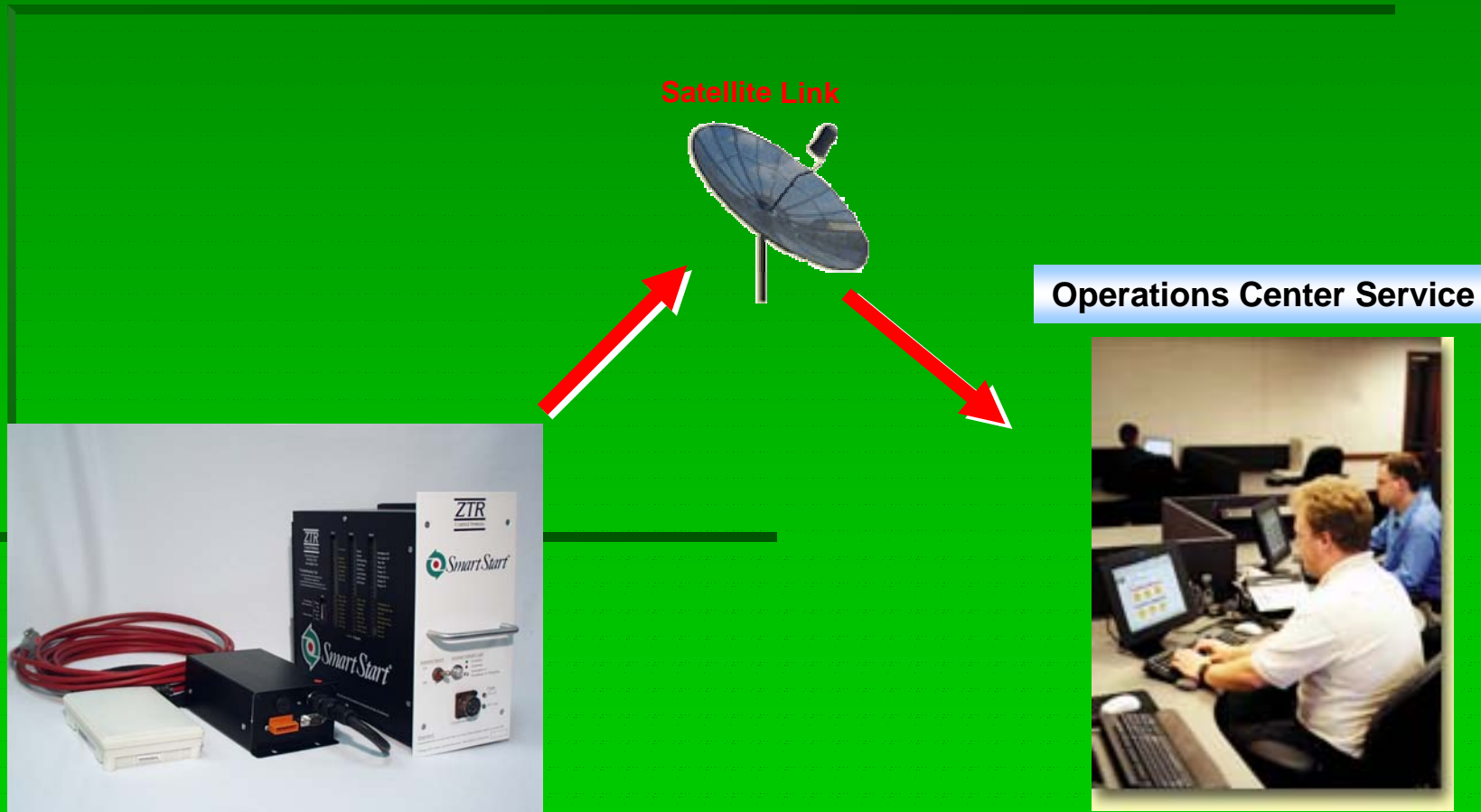
*Hmmmm.....sounds good....but then how do I
protect my investment?*

Now think in terms of:

- **Wireless Remote Downloading of Information from the Locomotive**
- **GPS**
- **Geo Fencing**
- **Secure Access to the Information over the Web**

We have been.....

Transmission Path




Access through the Internet

Welcome to MSN.com - Microsoft Internet Explorer

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Address  Y:\My Documents\SmartStart\Documentation\EPA\Welcome to MSN_com.htm Go Links

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- Kidman has a new guy?
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Your Business

- Check your credit (free)
- How to travel safely
- Why grooms toss garters

Mind & Body

- What is chronic fatigue?
- See if you could pass the US citizenship test
- Free beauty samples
- Find out your snacking personality

Urban areas & allergies

Is your city making you sick? Find out why

MSN Channels

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- City Guides
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- Health
- House & Home
- Kids
- Learning & Research
- Love & Relationships
- Mother's Day**
- News

MSN Top Headlines more... CNBC on MSN Money more...

<http://go.msn.com/0000/5/24.asp?target=http://www.bcentral.com/resources/travel.asp?cobrand=msn&LID=3800> Local intranet

Performance at a Glance.....

Report Management - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Print Mail News RSS

Address http://loco.ztr.com/Reports.asp Go

ZTR Control Systems - Report Management

2133

Reports | GPS | Help/Info | Home

Unit	Location	Date	% Parked Idle Reduced	Cumulative Savings	Average Savings per month
2133	OpCenter Download	2004-03-12 14:59:14	0	\$ 13535.20	\$ 712.38
2133	OpCenter Download	2004-03-11 15:32:14	26	\$ 13535.20	\$ 712.38
2133	OpCenter Download	2004-03-10 17:32:24	100	\$ 13519.57	\$ 711.56
2133	OpCenter Download	2004-03-10 15:20:14	97	\$ 13512.68	\$ 711.19
2133	OpCenter Download	2004-03-09 12:28:58	99	\$ 13447.24	\$ 707.75
2133	OpCenter Download	2004-03-04 14:41:24	100	\$ 13363.71	\$ 703.35
2133	OpCenter Download	2004-03-04 13:51:43	98	\$ 13360.88	\$ 703.20
2133	OpCenter Download	2004-02-10 13:26:22	0	\$ 13890.89	\$ 771.72
2133	OpCenter Download	2004-02-01 13:00:18	0	\$ 13890.89	\$ 771.72
2133	OpCenter Download	2004-01-25 13:03:18	0	\$ 13890.89	\$ 817.11
2133	OpCenter Download	2004-01-18 13:03:17	0	\$ 13890.89	\$ 817.11
2133	OpCenter Download	2004-01-14 15:08:17	100	\$ 13890.89	\$ 817.11
2133	OpCenter Download	2004-01-04 13:03:16	95	\$ 13871.45	\$ 815.97
2133	OpCenter Download	2003-12-28 12:58:41	83	\$ 13739.42	\$ 858.71
2133	OpCenter Download	2003-12-10 18:14:10	99	\$ 13496.02	\$ 843.50
2133	OpCenter Download	2003-12-09 14:15:50	71	\$ 13400.44	\$ 837.53
2133	OpCenter Download	2003-11-30 13:18:39	65	\$ 13343.74	\$ 889.58
2133	OpCenter Download	2003-11-23 12:58:34	59	\$ 13291.49	\$ 886.10
2133	OpCenter Download	2003-11-16 13:03:13	99	\$ 13103.17	\$ 873.54
2133	OpCenter Download	2003-11-09 12:58:33	82	\$ 12619.13	\$ 841.28
2133	OpCenter Download	2003-11-03 12:58:33	52	\$ 12152.50	\$ 828.17

All All All All All All

Clear Filters

Available Reports

- SmartStart Detail
- SmartStart Summary
- SmartStart Duty Cycle

View Report


Done Internet

http://loco.ztr.com/SmartStartReport.asp?Report=0&RecordID=1256 - Microsoft Internet Explorer

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Address http://loco.ztr.com/SmartStartReport.asp?Report=0&RecordID=1256 Go



SmartStart - Hotstart Detail Report

Rail Road: Burlington Northern Santa Fe Location: OpCenter Demo
Road Number: 2133



Reporting Period

	Installation	Previous Report	Current Report	Since Installation	Previous Report
Date:	8/30/2002	1/25/2004	2/1/2004	Days: 520.0	7.0
Time:	13:07:45	13:03:18	13:00:18	Hours: 12479.9	168.0

Locomotive Operating Statistics (Hours)

	Since Installation		Since Previous Report
In Service Hours:	10147.5	= 422.8 Days	168.0 = 7.0 Days
Out of Service Hours:	2332.4	= 97.2 Days	0.0 = 0.0 Days

	Since Installation	Since Prev. Report		Since Installation	Since Previous Report
ENGINE SHUTDOWN:	4953.0	0.0	IDLING:	4356.2	145.9
Manual:	1859.9	0.0	Working Idle:	2747.0	69.8
SmartStart:	3093.1	0.0	Parked Idle:	1609.2	76.1
ENGINE RUN:	5194.5	168.0	PARKED IDLE:	1609.2	76.1
Loading:	838.3	22.1	Unavoidable Idle:	790.1	32.6
Idling:	4356.2	145.9	Manageable Idle:	819.1	43.5

Unsatisfied Parameters Preventing Shutdown (Hours)

UNAVOIDABLE					
Ambient Temp:	644.5	32.5	Water Temp:	55.9	0.0
Dump Valve Temp:	84.2	0.1	High Water Temp:	0.0	0.0

MANAGEABLE					
Brake Pressure:	464.7	76.2	Battery Voltage:	0.0	0.0
Battery Charging:	142.8	0.1	Extended Idle:	14.7	0.0
Reverser not Centered:	280.8	0.0	SS Switch Off:	30.3	0.0
System Override:	132.6	0.7			

Reason(s) for Restart After SmartStart Shutdown (Counts) - Hotstart Shutdown (Counts)

Brake Pressure:	229	0	Ambient Temp:	18	0
Water Temp:	133	0	Battery Voltage:	0	0

Done Internet

GPS Latest Position.....

GPS Positions - Microsoft Internet Explorer

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ZTR Control Systems - GPS Positions

2133

Reports | GPS | Help/Info | Home

Selected Unit Info

Unit ID:
Date:
Latitude:
Longitude:
Speed:
Heading:

Zoom

Plotting Options

View Latest Position

View All Positions

Positions List

Date	Longitude	Latitude
2003-08-10	-87.7169	41.8207
2003-06-10	-87.7181	41.8207
2003-06-10	-87.7181	41.8208
2003-06-06	-87.7182	41.8203
2003-06-05	-87.7184	41.8198
2003-06-02	-87.7677	41.8372
2003-05-14	-90.3795	40.9201
2003-03-25	-87.7171	41.8204
2003-03-14	-87.7057	41.8044
2003-02-24	-87.7179	41.8208
2003-01-27	-87.7659	41.8375
2003-01-27	-87.7659	41.8374

Chicago Metro Area

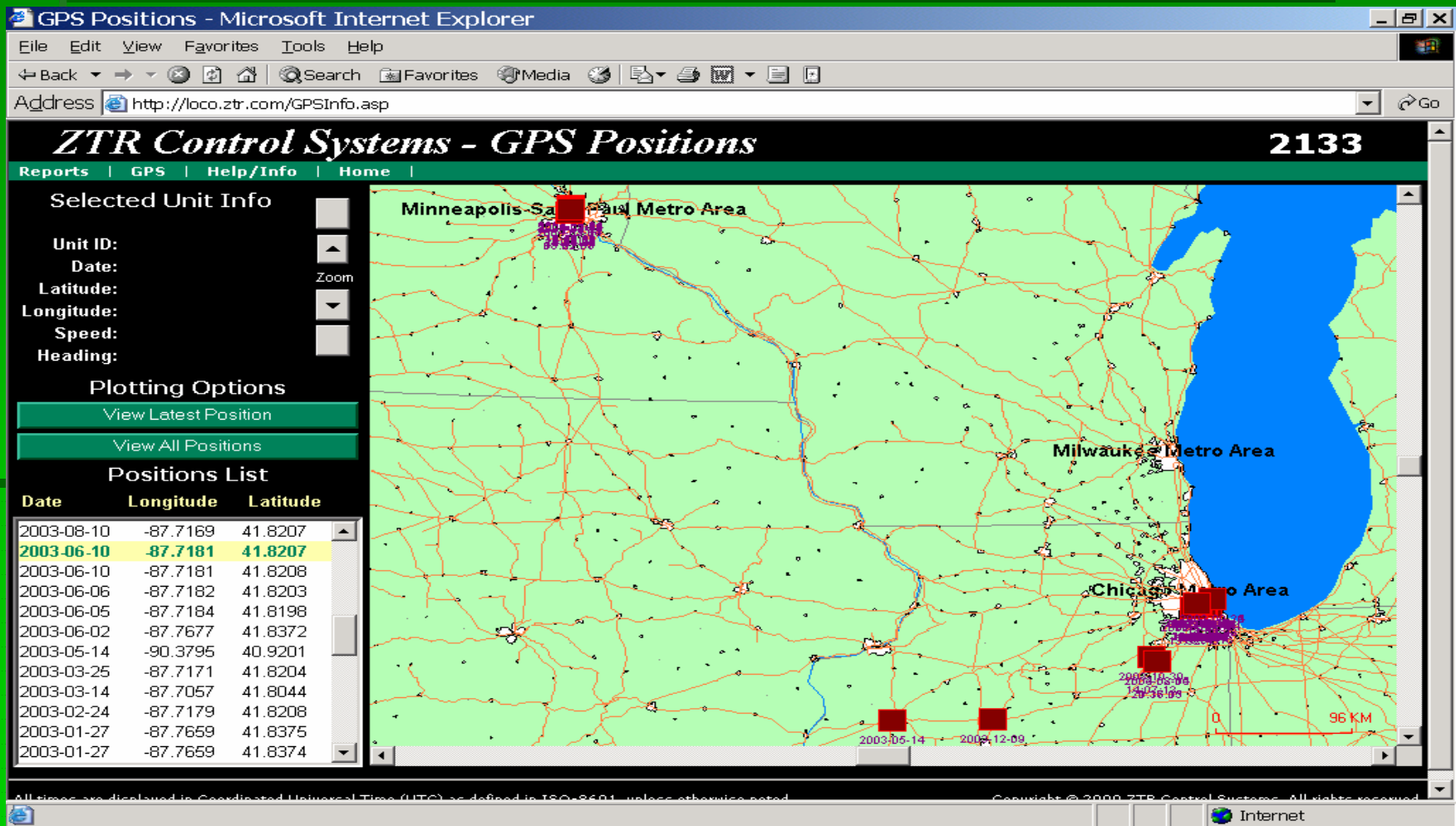
2003-06-10 13:48:37

0 7122 M

All times are displayed in Coordinated Universal Time (UTC) as defined in ISO-8601, unless otherwise noted. Copyright © 2000 ZTR Control Systems. All rights reserved.

Done Internet

GPS Historical View.....



In closing, I would like to say that ZTR Control Systems has been in the business of making the reduction of emissions a win-win situation for locomotive owners and the environmental community, for over 15 years. We plan to stay the course and to offer solutions that will continue this tradition. Let us know how we can help.

Thank You